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A COMPARISON OF VARIOUS TYPES OF TRUCK SHIPMENTS OF WASHED NON-DRIED EARLY IRISH POTATOES FROM CAMDEN, N.C. TO NEW YORK, N.Y. 1950 SEASON

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Summary

Washed non-dried potatoes were shipped in five different truck tests from Camden, N. C. to New York City during the last of June and the first of July, 1950. The potatoes carried well enough to sell readily in the terminal market but there were some apparent advantages and disadvantages to each method of truck shipment.

Potatoes shipped by semi-open trucks were usually cooler than ventilated van loads en route and arrived with little or no decay for that reason; but they were subject to considerable weight loss through evaporation which was probably indirectly responsible for at least part of the greater cooling of the load en route and was directly responsible for desiccation damage to the potatoes, particularly in the test bags loaded in the top and front layers. Ventilated loads in vans did not travel to market as cool as loads in semi-open trucks and a small amount of decay developed in most loads. Weight losses and desiccation damage were less in well ventilated van loads than in semi-open trucks. Solidly loaded vans under ventilation en route were warmer than well ventilated van loads. These contained more decay and showed the least weight loss and desiccation damage of any of the non-refrigerated types of truck shipments studied. Since decay on arrival is more likely to result in shipments being refused than are underweight bags or damage from desiccation, it would appear that shipment by semi-open trucks of washed non-dried potatoes should be studied on a commercial basis.

Refrigeration appears to be preferable for van loads of non-dried potatoes and would probably be more speedily accomplished by precooling with truck mounted units. It appears desirable in some instances to follow precooling with either ventilation or icing the day following in order to keep temperatures below 70°F. If precooling services cannot be obtained, icing at shipping point and once in transit in vans where air is circulated by a blower would be a moderately satisfactory substitute for precooling. Although icing costs less than precooling, fewer bags of potatoes can be hauled because of the weight of the ice and in addition cooling is slower than it is if the load is precooled. Except in very hot weather or shipments taking longer than 24 hours to reach market, precooling at shipping point should be sufficient.

Sebago appeared to carry better than Cobbler or Snowdrift because it is less subject to bruising. Digging potatoes the day before shipment did not affect their carrying quality. Potatoes damaged by exposure, even severely, developed little decay in these truck tests. Bruised material did not carry well because it developed a relatively high percentage of decay en route. Potatoes damaged by mechanical

injuries were much more likely to develop decay in transit than those damaged by desiccation. Desiccation from exposure in the field or drying en route made the potatoes unattractive.

Introduction

In recent years emphasis has been placed on providing the consumer with washed potatoes that are relatively free from defects and have shallow eyes. However, most of the potatoes shipped from eastern North Carolina and the eastern shore of Virginia are still not washed. The pressure of competition is causing considerable interest in washing even though earlier attempts failed to establish the practice (1 and 2). 1/ Factors which are causing renewed interest are: (a) slightly higher prices and more ready sales for washed potatoes; (b) the swing to truck shipments which, because they are usually faster, do not provide decay organisms as much time to do as much damage as in rail shipments; (c) the fact that a few sheds have practised washing or washing and drying without any particular difficulty for 2 or 3 years; and (d) probably of most importance, the shift from Cobbler to Sebago, a variety with shallow eyes, some disease resistance, and an ability to withstand handling and exposure better than many other varieties. The Sebago variety has become popular in the Hastings, Florida, and in the Charleston, S. C., areas. While Sebago has some cultural disadvantages, its desirable qualities make it suited for shipping and handling and it is better in appearance after washing than the Cobbler. As a result about one-fifth of the acreage in North Carolina and Virginia was planted to Sebago in the 1950 season and considerable interest in washing potatoes developed.

In view of the attempts by shippers to convert to washing without the additional expense of drying, the short haul by truck to most markets served by these areas, and previous experience obtained in a two year survey (3) as well as that reported for Baldwin County, Alabama (8), it was decided to test as thoroughly as possible the feasibility of shipping washed non-dried potatoes by truck, with and without refrigeration to New York City.

Methods

Five truck shipping tests were made during the latter part of June and the first part of July, 1950, from Camden, N. C. An outline of these tests is given in Table 1. All the potatoes were washed but not dried, except in Test 3, and were packed in 100 pound burlap bags. In Test 3 the potatoes were either dry graded, washed, or washed and dried. The trucks used were essentially of two kinds: (a) the conventional van with 1 1/2 to 2 inches of insulation in walls and ceiling and an ice bunker in the front end; or (b) a semi-open bodied truck. The loads in the trucks were arranged either to allow air circulation through the load (ventilated load with layers usually arranged 5-3-2 or 5-3-3-1 in a stack) or to restrict air circulation through the load (solid load without air channels). All the semi-open trucks carried the solid load while the vans were loaded either with solid or ventilated loads. The placement of the load varied somewhat because of the construction of the trucks.

Test lots were of two kinds; (a) potatoes from the commercial lots being packed that day (regular test bags) and, (b) test lots designed to answer some special question (special test bags). The regular test bags were placed in three positions in each truck. These were: (a) top layer, stack one, i.e. the most exposed position available in either the semi-open trucks or the vans; (b) top layer, middle stack of the load, i.e. where air passed readily over the bags;

1/ Numbers in parenthesis refer to literature cited on page 9.

and (c) middle layer (or upright bag in ventilated loads), middle stack of the load, i.e. representing the bulk of the bags in the load. The special test bags were all placed alongside the regular test bag in the middle layer, middle stack of the load, and for that reason were compared with the performance of the bags in that position.

The test bags included in Test I all came from one field truckload of potatoes dug the day of loading. The semi-open truck used had sides that were solid from the floor up to a height of about 20 inches and were slatted from there to the top with $\frac{1}{2}$ to 1 inch openings between the slats. A tarpaulin covered the top of the load and partially shielded the test bag in the top layer of the first stack. The insulated van was of conventional construction with the exception that the bunker was baffled to divert air up over the load. Both trucks had a Ryan recording thermometer in the center of each load and a portable hygrothermograph was attached to the outside wall of the semi-open truck. Both loads were stacked to restrict air circulation (solid).

In Test 2, three trucks were used. The regular test bags came from three separate field loads; one of Cobblers dug the day of shipment, one of Cobblers dug in the afternoon the day before shipment, and one of Sebagos dug the day of shipment. The semi-open truck had sides that were solid to a height of about four feet from the floor and were of slatted construction above this level. The top of the truck was covered with a tarpaulin. The van with the ventilated load had no bunker. The potatoes were stacked back from the front wall to leave a space similar to a bunker. This provided ample opportunity for the air coming in through the vents to circulate through the load. The third truck in this test was a van carrying a load stacked to provide a minimum of ventilation through the load (solid). This van contained a bunker which allowed the air to move directly back over the load after coming into the truck through the air ports. There was little access of air to the load other than from the top. A Ryan recording thermometer was placed in the center of each load and a portable hygrothermograph was placed on the outside wall of the semi-open truck. The purpose of the test was threefold, (1) to compare varying degrees of ventilation as determined by truck construction and loading methods, (2) to compare carrying quality of Sebago and Cobbler potatoes, and (3) to compare potatoes dug the day before loading with freshly dug potatoes.

In Test 3 all three trucks were of the van type and the purpose of the test was to compare the carrying quality of non-washed, washed, and washed and dried potatoes. The potatoes all came from one field making the loads as comparable as possible. The non-washed potatoes were run over a Boggs dry grader. The washed potatoes were run over a Boggs dry grader into which a washer made by the American Potato Dryer Co., Inc. had been inserted. The washed and dried potatoes were run over an American Machinery Corporation washer and hot air dryer. After grading, the potatoes from this machine were judged to be only fairly dry.

In addition to the regular test bags, some special test bags were also included in this test. These bags were prepared in the same manner as the other potatoes in the truck in which they were shipped but prior to their preparation they had been exposed on the ground for approximately $2\frac{1}{2}$ hours after digging. Part of these test potatoes were exposed essentially as the digger left them, i.e. with about 5% of the skin removed; the other part was rolled in a burlap bag to remove additional skin before exposure. About 25% of the skin was removed from

the potatoes. Temperatures were taken with thermometers in the exposed cortex of several of the potatoes during the exposure period.

The evaporation rate was measured with a Livingston white porous porcelain atmometer bulb (coeff. 0.77). The purpose of the special test bags was to determine how well damaged and heated potatoes carried in transit. A Ryan recording thermometer was placed in the middle of each load, and a portable hygrothermograph was placed behind a vent in the bunker of the van carrying the washed and dried potatoes. It should be noted that this van had a baffled bunker which threw the air up over the load while the other two vans allowed the air to move directly into the truck.

In Test 4 the regular test bags were again all obtained from one field. The sides of the semi-open truck used in this test were slatted from the floor up with about 1/4 inch openings between the slats and the load was covered with a tarpaulin. The two vans were similar and contained ventilated loads. One van was precooled and went to destination with vents closed. 2/ The other van, as in previous tests, was sent with all vents open. Special test bags consisted of material damaged by 1 and by 2 hour exposures after digging in the field, and also one bag containing only bruised potatoes. 3/ In addition a bag of the promising variety Snow Drift was included in the ventilated van load. The purpose of this test was to compare semi-open truck, ventilated van, and precooled van loads, and also to compare the carrying quality of materials damaged by exposure or handling.

In this test distant reading electric resistance thermometers were placed in 10 to 12 locations both in the air and in the commodity and one of the test party accompanied the three trucks to New York City and took periodic readings en route. The precooled van was loaded first and was precooled while the other trucks were being loaded. Unfortunately, the semi-open truck had to stop temporarily at Salisbury, Maryland, and the record was incomplete for this truck.

Test 5 was a comparison of an iced and a precooled van load to determine if icing alone would suffice. Unfortunately, the iced van did not carry a full load because the shipper could not supply enough potatoes. The test bags all came from one field load. The loads were stacked to allow ventilation. The precooled van had to have the vents opened near the end of the trip to help cool the load. The iced van had the alternate vents partially opened after the second icing in order to hasten cooling of the load. Temperatures were taken with distant reading electric resistance thermometers as in Test 4.

At shipping point, samples of all the test material were collected and examined to determine the approximate condition of the potatoes being used in test bags 4/. These data are given in Table 2 and reference will be made to them later. All the test bags were collected in the terminal market and examined soon after arrival and again after holding approximately five days.

2/ Precooled by a truck mounted unit.
3/ Either found in the material or bruised by the test party.
4/ Except for some of the exposed lots in Test 4.

Results

All of the potatoes in the truck loads in these tests were accepted without complaint in the terminal market. This reflects their generally satisfactory condition on arrival and is an indication of the relatively small differences found between the different loads despite having been prepared or shipped in different ways.

Probably the most important factor controlling decay in shipments of early Irish Potatoes is temperature, since shipments that travel to market above 70°F. for any appreciable length of time tend to develop soft rot (4). The development of soft rot in shipments exposed to temperatures above 70°F. has been found to be nearly in proportion to the amount of cut and bruised material present in the load (3).

The temperatures obtained with the Ryan recording thermometers in the center of each load in Tests 1, 2, and 3 are given in Figure 1. Also shown on these graphs are the air temperatures recorded by the portable hygrothermographs in the respective tests. All three trucks in Test 3 were vans traveling with vents open to destination. Although they were loaded at different temperatures and left the shipping point at different times during the day, they maintained nearly the same temperatures in the center of the load throughout most of the trip. This indicates that an equilibrium was reached soon after departure between heat removed by ventilation and heat gained or produced by the load, regardless of shipping time, or whether they had been dry graded, washed, or washed and dried.

In comparing these data it can be seen that the semi-open truck in both Tests 1 and 2 was the coolest en route,while the well ventilated van load of Test 2 was intermediate and the solid van loads were the warmest. In view of the similarity of the temperatures of the trucks in Test 3 it appears that the only major difference between the trucks of Tests 1 and 2 was the amount of ventilation provided. The load in the semi-open truck cooled with the night air but contrary to expectations the temperatures did not rise again with rising air temperatures the following day. Cooling with low night temperatures had less effect on the poorly ventilated vans but they, too, failed to warm up in the center of the load with rising air temperatures.

In Test 4 (Figure 2) there was apparently very little difference between the semi-open truck and the ventilated van load even though the record is incomplete for the former. However, it is known that these trucks experienced rain during the day following loading while the hygrothermograph records for Tests 1, 2, and 3 indicate clear weather en route. It is unfortunate that outdoor air temperatures were not available for Test 4 because the cooling of the loads apparently depended on how well ventilated they were and how low the temperatures dropped at night. In Test 4 the data indicate the night temperatures did not drop appreciably and rain prevented much evaporation during the day. This may account for the fact that the better ventilated semi-open truck used in Test 4 did not produce temperatures different from those in the ventilated van.

It should be pointed out that this explanation conforms with data obtained earlier on truck shipments from Alabama to Chicago, Illinois (8), and also provides an explanation of why open bodied trucks appeared to develop more decay on going through rain (3).

The precooled vans in Tests 4 and 5 (Figure 2) were initially cooled below 70°F., but not to 60°F., in 3 to 4 hours but after leaving the shipping point the commodity temperatures rose above 70°F. in about 6 to 8 hours. In the iced van the temperature was above 70°F. during the first part of the trip but after the second icing it dropped below 70°F. and the van arrived cooler than the precooled load. Therefore, it would appear desirable in very hot weather to follow precooling with icing en route to maintain sufficiently low temperatures. If the load in the iced van had been larger the load probably would have cooled more slowly.

If temperatures above 70°F. encourage bacterial soft rot, the solidly loaded van in Test 2 and the trucks of Test 4 should show the greatest development of it en route. The regular test bags from these trucks showed decay more consistently than others in these tests, but decay was found in small amounts in other trucks (Table 3). The only truck in which the test bags averaged considerably over 1 percent decay was the solidly loaded van of Test 2. The semi-open trucks had no decay on arrival in Tests 1 and 2 and only one-half of one percent in Test 4 that went through rain. This was the least decay of any of the non-refrigerated types of loads. The precooled (or iced) loads were not free of decay.

In the ventilated van load of Test 2, Cobblers dug the day of shipment showed fewer test bags with decay but averaged more decay than Cobblers dug the day before shipment. The Sebagos in this van averaged less decay than either lot of Cobblers indicating a probable difference between the two varieties because of the difference in the ease with which they are bruised (Table 2).

Since no decay developed in any of the regular test bags in Test 3, conclusions cannot be drawn on whether washing or washing and drying had any effect on carrying quality.

Decay that developed while holding the material after arrival was slight and not particularly indicative of the effect of the shipping conditions.

The average performance of the test bags is not an accurate measure of the performance of the entire truck loads since two of the test bags were located in exposed positions while the third was near the center of the load. This third bag would probably be more representative of the bulk of the load while the other two probably represent only about a tenth to a fifth of the load.

Weight losses en route are the concern of every shipper because complaints sometimes arise from the arrival of underweight bags in the terminal market. It has been shown earlier (3) and in previous shipments from Alabama (8), that weight losses are greater from open trucks than from vans. This was true in these tests also (Table 4). Although nearly all the trucks contained non-dried potatoes, all bags arrived dry except a few on the front end of the semi-open truck that encountered rain en route. It would, therefore, not appear necessary to dry potatoes prior to shipment to avoid wet bags in the market.

As expected, the test bags in the semi-open trucks lost more weight in all positions and tests than the van loads. The ventilated van load of Test 2 lost more weight than the poorly ventilated solid load in this test. Weight loss was lowest in the precooled or iced vans.

It is not easy to compare the weight lost in the semi-open trucks in the different tests because the difference in construction and the placement of the tarpaulin affected ventilation. However, the test bags on the semi-open truck that went through rain (Test 4) lost considerably less weight than comparable bags in Tests 1 and 2.

By calculating the evaporating power of the air from the temperature and relative humidity readings of the hygrothermographs it is possible to obtain a comparison of the dryness of the air through which the first three tests went. This figure which represents the amount of water vapor that would be needed to bring the humidity of the air to 100 percent at the prevailing temperature is usually expressed by the term vapor pressure deficit. In Figure 3 the cumulative vapor pressure deficit during each test is given. It would appear that the trucks of Test 2 experienced almost a continuous drying en route while the trucks of Tests, 1 and 3 went through drying weather only during the daylight hours.

It appears that weight lost in transit in these tests reflects the amount of ventilation in and around the potatoes, the dryness of the air, and the amount of skin removed from the potato in harvesting and handling (Cobbler vs. Sebago in Test 2).

Although evaporation may aid in cooling the potatoes, appreciable loss of water en route would be undesirable. Excessive desiccation may result in browning and scald spots (5), and in these tests some of this damage was found (Table 5). Generally speaking, scald spots were not noticeable or at least not severe on arrival, but were especially noticeable in the top layer bags after holding 5 days. They were worse in the front stack than in the center of the load. Potatoes in the test bags in the semi-open trucks usually developed more scald spots than bags in the van loads. In view of the fact that this damage was seen in only small amounts on arrival and was severe in only the top layer of stack 1 after holding, they usually do not give much trouble in normal handling in the market. A more serious objection to the open trucks may be the high weight losses.

The trucks of both Tests 3 and 4 contained some special test bags in addition to the regular test material. The temperature of the potatoes exposed in the field as the digger left them (exposed only lot) rose more rapidly than those having additional skin removed by being rolled in a burlap bag and then exposed (skinned and exposed lot). The potato temperatures eventually reached nearly 103°F. and 98°F., respectively (Figure 4). These temperatures were apparently not high enough to cause heat injury or sublethal temperatures as described by Rose (4) and Nielson (6,7), but evaporation produced desiccation damage (Table 2). The skinned and exposed lot showed more sticky scald spots than in the exposed only lot.

Despite the fact that desiccation damage was greater in both lots of exposed potatoes in Test 3 than found in any commercially handled material during a previous survey of the southeastern states (3), very little decay developed in transit. If the temperatures in transit had been higher it is quite possible that more decay would have been present. The exposed only lot was the only one showing decay on arrival (Table 6). Although this lot did not have as great an amount of sticky scald at loading as the skinned and exposed lot, it contained more cut and bruised material. The combination of high loading temperatures and great amounts of cut and bruised material in the exposed only lots may account for the soft rot.

In each truck of Test 3 the exposed only potatoes lost more weight in transit than those skinned and exposed and they in turn lost more weight than the check bags of potatoes. This relationship is in proportion to the loading temperatures except in one instance (skinned and exposed bag of potatoes in washed and dried van). It, therefore, appears that heat lost from the exposed potatoes was at least partially through evaporation and the warmer the potatoes the more heat that was lost through evaporation in each truck.

Even though shipped in different ways, this difference in weight losses from exposed and non-exposed potatoes occurred again in Test 4, but not to the same extent. The exposed material also developed a little more decay en route although there was little or no difference between the potatoes exposed one or two hours. Loading temperatures and samples were not collected for this material and it is not known whether the exposed potatoes were loaded warmer or contained more mechanical damage than the check bags.

The special test bags containing only bruised potatoes developed considerable decay en route, more in the ventilated van than in the semi-open truck, and more in the semi-open truck than in the precooled van. The special test bag of the Snow Drift variety developed considerable decay en route also. This verified observations at shipping point that this variety was prone to develop decay in small bruises.

In general it appears that bacterial soft rot is more apt to develop in transit at mechanical injuries than at tissues damaged by desiccation. The potatoes damaged by desiccation were very unattractive.

Discussion

It cannot be definitely stated from the information given above that one method of shipment is better than another, as each has its advantages and disadvantages. Well ventilated truck loads have the advantage of rapid cooling with low night temperatures and a tendency to remain cool in clear weather. Evaporation, however, causes excessive weight losses and desiccation damage to the potatoes in the outside layer of bags. If this objection is not too serious the semi-open truck offers the best opportunity to avoid the development of bacterial soft rot en route without the use of costly refrigeration.

According to federal grade standards, sunken or discolored areas (scald spots) which are sticky are scored against all grades at shipping point but in the terminal market they are also scored against all grades as a condition factor. If these scald spots were not sticky they are scored as a condition factor at both shipping point and the terminal market. Since bacterial soft rot is more objectionable than underweight bags or scald injury, shippers may find semi-open truck more satisfactory for short hauls than closed vans. One shipper in the area has sent semi-open trucks carrying washed and dried potatoes to New York for at least 3 years without any known difficulty. Further testing of this method of shipment would be desirable.

Precooled van shipments, using well insulated and tight trucks, appear to be the safest means of shipping washed non-dried potatoes. The benefit of precooling is temporary, however, and often needs to be supplemented by either ventilation or icing depending on the weather conditions en route and the length of the trip.

Both precooling and icing allow only small weight losses or damage from desiccation en route, but icing alone will not cool the load as quickly as precooling. The capacity of the truck would be reduced by approximately the weight of the ice. The charge for two icings per van load totaled $10.50 in this study.

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Table 1. An Outline of Truck Shipping Tests Made from Camden, N. C. to New York City, June - July, 1950.

TEST	METHOD OF SHIPMENT	VARIETY	METHOD OF PREPARATION	No. BAGS IN LOAD	SPECIAL TREATMENT	POSITION OF TEST BAGS 1/
1 a	semi-open truck	Cobbler	washed only	225	None	1,2*, 3*
b	van, solid load	"	" "	300	"	1,2*, 3*
2 a	semi-open truck	Cobbler	" "	209	dug day of shipment	1,2, 3*
	" " "	"	" "	209	" " before "	1,2,3
	" " "	Sebago	" "	209	" " of "	1,2,3
b	van, solid load	Cobbler	" "	275	" " of "	1,2,3*
c	van, vent. load	Cobbler	" "	275	" " " "	1,2,3*
	" " "	"	" "	275	" " before "	1,2,3
	" " "	Sebago	" "	275	" " of "	1,2,3
3 a	van, vent. load	Cobbler	dry graded	275	None	1,2,3*
	" " "	"	" "	275	exposed only	3
	" " "	"	" "	275	skinned & exposed	3
b	van, vent. load	"	washed only	275	None	1,2,3*
	" " "	"	" "	275	exposed only	3
	" " "	"	" "	275	skinned & exposed	3
c	van, vent. load	"	washed & dried	250	None	1,2,3*
	" " "	"	" " "	250	exposed only	3
	" " "	"	" " "	250	skinned & exposed	3
4 a	semi-open truck	Sebago	washed only	210	None	1,2,3
	" " "	"	" "	210	exposed 1 hour	3
	" " "	"	" "	210	" 2 hours	3
b	van, vent. load	"	" "	250	None	1,2,3
	" " "	"	" "	250	exposed 1 hour	3
	" " "	"	" "	250	exposed 2 hours	3
	" " "	S.Drift	" "	250	None	3
c	van, precooled	Sebago	washed only	247	None	1,2,3
	" "	"	" "	247	exposed 1 hour	3
	" "	"	" "	247	" 2 hours	3
5 a	van, precooled	"	" "	300	None	1,2,3
b	van, iced	Sebago	" "	205	None	1,2,3

1/ Position 1 is top layer, stack 1 (next to front vent), position 2 is top layer, middle stack (about half way back in the truck), and position 3 is middle layer, middle stack (essentially the center of the load) or the upright bags in a ventilated load.

* Contained a Ryan recording thermometer.

Table 2 - Amount of Defects Found in Samples Collected from Test Lots after Grading - Camden, N. C., June - July 1950

TEST NO.	VARIETY	TREATMENT	ESTIMATED SKIN REMOVED	DIGGER CUTS	BAD BRUISES[1]	OTHER CUTS AND BRUISES	BROWNING	SCALD SPOTS	STICKY SCALD SPOTS	BACTERIAL SOFT ROT	INSECT DAMAGE	DEEP PITTED SCAB	GREENING
			%	pounds per hundred									
1 a	Cobbler	washed	66	0.6	6.0	44.0	--	5.2	--	--	1.2	--	0.3
b	"	"	60	0.9	8.6	33.1	--	7.0	--	--	1.6	1.2	0.6
2 a	Sebago	washed, dug day of shipment	92	--	0.2	3.4	0.3	0.5	--	--	12.8	0.3	--
b	Cobbler	washed, " " " "	70	1.3	9.1	31.6	--	0.5	--	--	0.5	--	--
c	"	" " " before "	75	--	4.5	39.2	0.2	--	--	--	--	--	--
3 a	Cobbler	dry graded	35	0.1	2.4	30.6	3.4	2.8	1.6	--	2.0	1.4	--
b	"	washed	90	3.6	5.6	50.5	1.5	1.3	--	--	2.1	--	--
c	"	washed & dried	50	0.5	2.9	33.1	6.3	6.1	1.8	--	1.1	--	--
a	"	exposed, dry graded	20	0.3	2.2	20.6	--	38.2	24.8	0.3	1.1	--	--
b	"	exposed, washed	25	--	--	17.5	--	23.5	45.4	--	--	--	--
c	"	exposed, washed & dried	--	--	--	(not obtained)		--	--	--	--	--	--
a	"	skinned & exposed, dry graded	60	--	--	3.1	--	16.8	63.2	--	--	--	--
b	"	skinned & exposed, washed	60	--	3.1	3.1	--	6.7	86.2	--	--	--	--
c	"	skinned & exposed, washed & dried	45	--	--	4.7	--	7.4	84.4	--	--	--	--
4	Sebago[2]	washed	70	--	1.8	--	--	13.0	1.6	--	16.5	--	--
	Snowdrift	washed	--	--	--	27.5	--	--	--	9.7[3]	--	--	0.8
5	Sebago	washed	75	--	--	6.0	--	--	--	--	1.4	--	--

1/ Exceeds tolerance of 5 percent waste for U.S. #1 grade standards.
2/ Samples of exposed potatoes not obtained.
3/ Early stages of decay.

Table 3 - Soft Rot in Regular Test Bags on Arrival in the Terminal Market and After Holding 5 Days in Truck Shipments from Camden, N. C., June - July, 1950.

TEST No.	METHOD OF SHIPMENT	VARIETY	METHOD OF PREPARATION	On Arrival Position of Test Bag (Layer-Stack-) TOP FRONT	TOP MIDDLE	MIDDLE MIDDLE	AVERAGE 1/	After Holding Position of Test Bag TOP FRONT	TOP MIDDLE	MIDDLE MIDDLE	AVER. 1/
				%	%	%	%	%	%	%	%
1 a	semi-open truck	Cobbler	washed only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	van, solid load	"	" "	0.0	0.0	1.2	0.4	0.0	0.0	0.0	0.0
2 a	semi-open truck	"	washed only, dug day of ship.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	" " "	"	" " , dug day before ship.	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1
	" " "	Sebago	" " " " of "	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.9
b	van, solid load	Cobbler	" " " " of "	6.8	0.0	4.1	3.6	1.5	0.0	0.0	2/ 0.5
c	van, vent. load	"	" " " " of "	0.0	0.0	4.7	1.6	0.0	0.0	0.3	3/ 0.1
	" " "	"	" " " " before "	0.3	1.0	0.0	0.4	0.0	0.0	0.0	0.0
	" " "	Sebago	" " " " of "	0.0	0.0	0.5	0.2	0.2	0.0	0.0	0.1
3 a	van, vent. load	Cobbler	dry graded	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	" " "	"	washed only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	" " "	"	washed & dried	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 a	semi-open truck	Sebago	washed only	0.0	1.4	0.0	0.5	0.0	0.0	0.0	0.0
b	van, vent. load	"	" "	0.6	0.0	0.2	0.3	0.0	0.0	0.3	0.1
c	van, precooled	Sebago	" "	2.4	0.2	0.0	0.9	0.0	0.0	0.0	0.0
5 a	van, precooled	Sebago	washed only	0.0	0.0	0.2	0.1	0.0	0.8	0.0	0.3
b	van, iced	"	" "	0.5	1.6	0.0	0.7	0.8	0.0	0.3	0.4

1/ Does not represent an average of the load.
2/ Heavy lenticel infection.
3/ Slight to moderate lenticel infection.

Table 4 - Weight Losses En Route from Regular Test Bags, in Truck Shipments from Camden, N. C. to New York City, June - July, 1950.

				WEIGHT LOSS			
TEST NO.	METHOD OF SHIPMENT	VARIETY	METHOD OF PREPARATION	(Layer-TOP (Stack-FRONT %	TOP MIDDLE %	MIDDLE MIDDLE %	1/ AVERAGE %
1 a	semi-open truck	Cobbler	washed only	9.25	2.45	3.72	5.14
b	van, solid load	"	" "	3/ 2.34	(2.24)	2.14	2.24
2 a	semi-open truck	Cobbler	washed only, dug day of ship	8.11	4.06	2.54	4.90
	" " "	"	" " " " before "	5.68 2/	3.71	2.73	4.04
	" " "	Sebago	" " " " of "	12.96	5.35	3.50	7.27
b	van, solid load	Cobbler	" " " " of "	3.53	3.14	1.17	2.61
c	van, vent. load	"	" " " " of "	4.93	3.06	1.75	3.25
	" " "	"	" " " " before "	3.41 2/	3.62	1.95	2.99
	" " "	Sebago	" " " " of "	5.97	4.10	1.86	3.98
3 a	van, vent. load	Cobbler	dry graded	2.75	2.58	1.43	2.25
b	" " "	"	washed only	2.94	0.97 4/	0.79	1.57
c	" " "	"	washed and dried	1.63 3/	1.32	1.34	1.43
4 a	semi-open truck	Sebago	washed only	3.72	2.44	1.96	2.71
b	van, vent. load	"	" "	2.36	2.06	1.28	1.90
c	van, precooled	"	" "	1.17	1.55	1.27	1.33
5 a	van, precooled	Sebago	washed only	2.06	1.06	1.07	1.40
b	van, iced	"	" "	1.27	1.28	1.37	1.31

1/ Does not represent an average of the load.
2/ In second stack from front vent.
3/ Vent in bunker baffled to throw air up over the load but vented at bottom to allow air to enter load from the bottom of the bunker.
4/ No vent at bottom of bunker.

Table 5 - Scald Spots in Regular Test Bags on Arrival in the Terminal Market and After Holding 5 Days in Truck Shipments
from Camden, N. C. to New York City, June - July, 1950.

TEST NO.	METHOD OF SHIPMENT	VARIETY	METHOD OF PREPARATION	(Layer (Stack	On Arrival Position of Test Bag Percent by Weight Loss TOP FRONT	 TOP MIDDLE	 MIDDLE MIDDLE	 2/ AVERAGE	After Holding Position of Test Bag Percent by Weight Loss TOP FRONT	 TOP MIDDLE	 MIDDLE MIDDLE	 2/ AVERAGE
1 a	semi-open truck	Cobbler	washed only		0.0 2/	1.7	2.0	1.2	0.0 2/	1.7	2.0	1.2
b	van, solid load	"	" "		1.5	3.4	2.0	2.3	2.8	3.6	2.0	2.8
2 a	semi-open truck	"	washed only, dug day of ship		0.0 3/	0.0	0.4	0.1	12.9 3/	0.8	0.0	4.6
	" " "	"	" " " " before "		1.4	0.5	0.3	0.7	1.4	0.6	0.7	0.9
	" " "	Sebago	" " " " of "		0.0	0.4	0.0	0.1	22.0	6.8	0.0	9.6
b	van, solid load	Cobbler	" " " " of "		1.3	0.0	0.0	0.4	1.3	0.0	0.0	0.4
c	van, vent. load	Cobbler	" " " " of "		1.7	2.0	0.3	1.3	1.7	2.0	0.3	1.3
	" " "	"	" " " " before "		0.4 3/	0.0	1.3	0.6	0.4 3/	0.0	1.3	0.6
	" " "	Sebago	" " " " of "		0.5	5.1	0.0	1.9	0.5	3.2	0.0	1.7
3 a	van, vent. load	Cobbler	dry graded		0.0	0.0	0.3	0.1	7.0	1.8	4.0	4.3
b	" " "	"	washed only		-- 4/	0.0	0.9	0.3	4.0	1.1	1.3	2.1
c	" " "	"	washed & dried		0.8	0.0	0.0	0.3	10.0	3.0	5.0	6.0
4 a	semi-open truck	Sebago	washed only		0.0	0.0	0.3	0.1	0.3	0.0	0.3	0.2
b	van, vent. load	"	" "		0.0	0.0	0.7	0.2	0.8	0.6	0.4	0.6
c	van, precooled	"	" "		5.3	0.6	0.0	2.0	10.5	0.6	1.3	4.1
5 a	van, precooled	Sebago	washed only		0.4	1.1	0.0	0.5	0.4	0.7	0.0	0.4
b	van, iced	Sebago	washed only		0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.6

1 Nearly all scald spots were sticky on arrival and approximately fifty percent were sticky after holding.

2/Does not represent an average of the load.

3/Top layer of second stack from front.

4/Figure so high as to be an obvious error.

5/Browning very high, canvas protected test bag some.

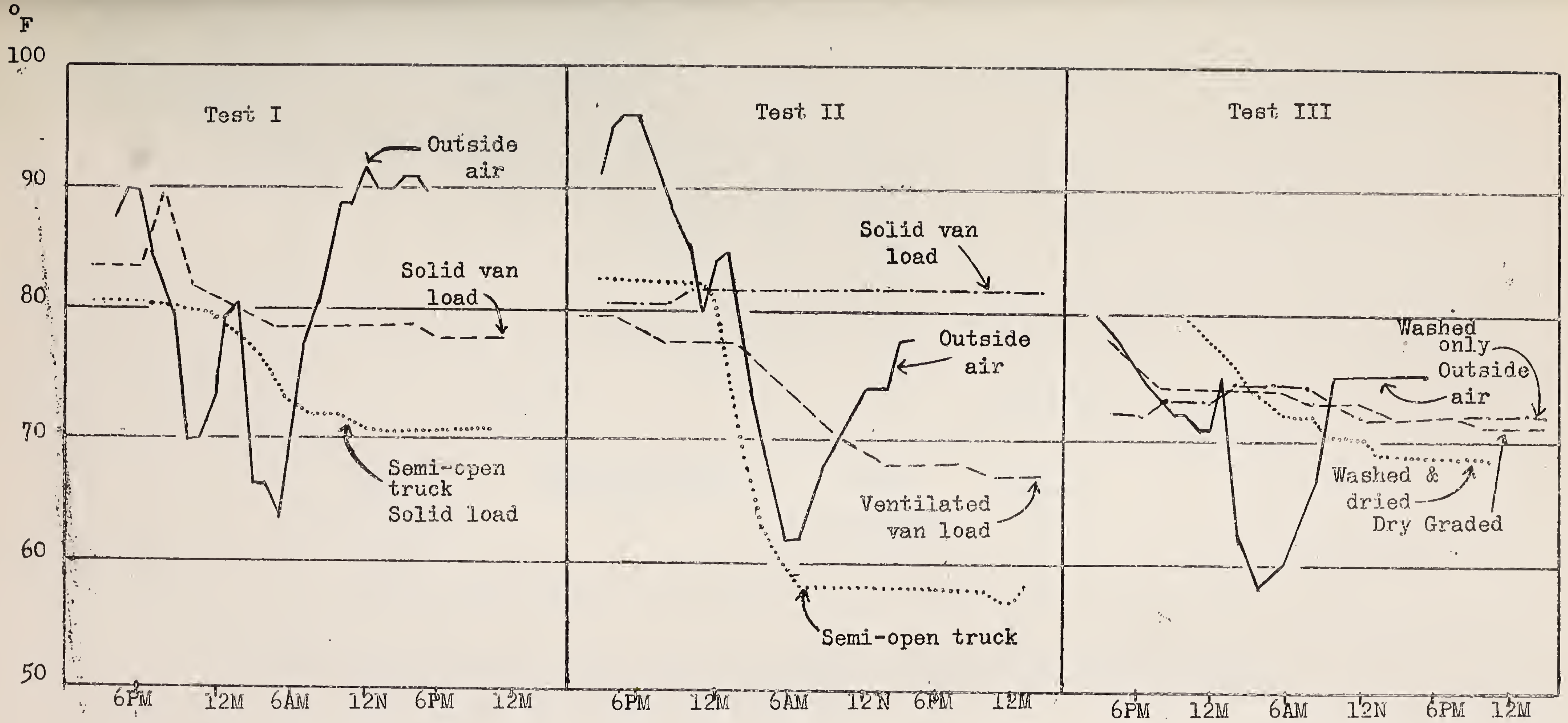

Fig. 1. Temperatures recorded near the center of the loads with Ryan Recording Thermometers and temperatures of the outside air recorded with a protected portable hygrothermograph in Tests I, II, and III from Camden, N. C. to New York City, June-July 1950.

Note: The abrupt rise in outside air temperature during the night hours occurred while on board the Cape Charles Ferry Boat.

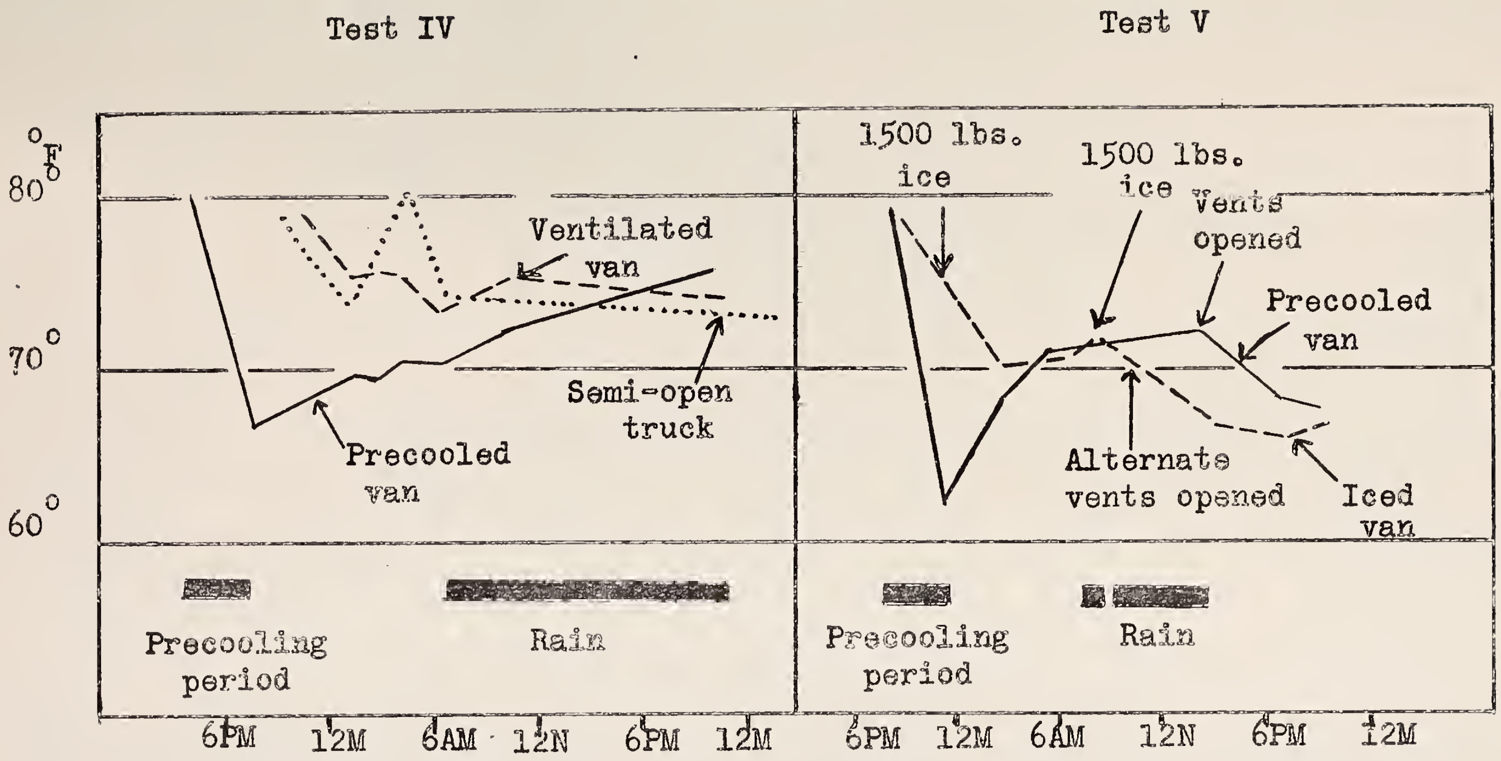

Fig. 2. Average top layer commodity temperatures[1/] obtained with distant reading electric resistance thermometers in Tests IV and V from Camden, N. C. to New York City, June-July 1950.

[1/] Note: Top layer not greatly different from remainder of load in these tests. Precooled loads tended to be warmer on top than on bottom, while iced loads were just the reverse. The difference between top and bottom temperatures in the five trucks above was usually less than 3°F.

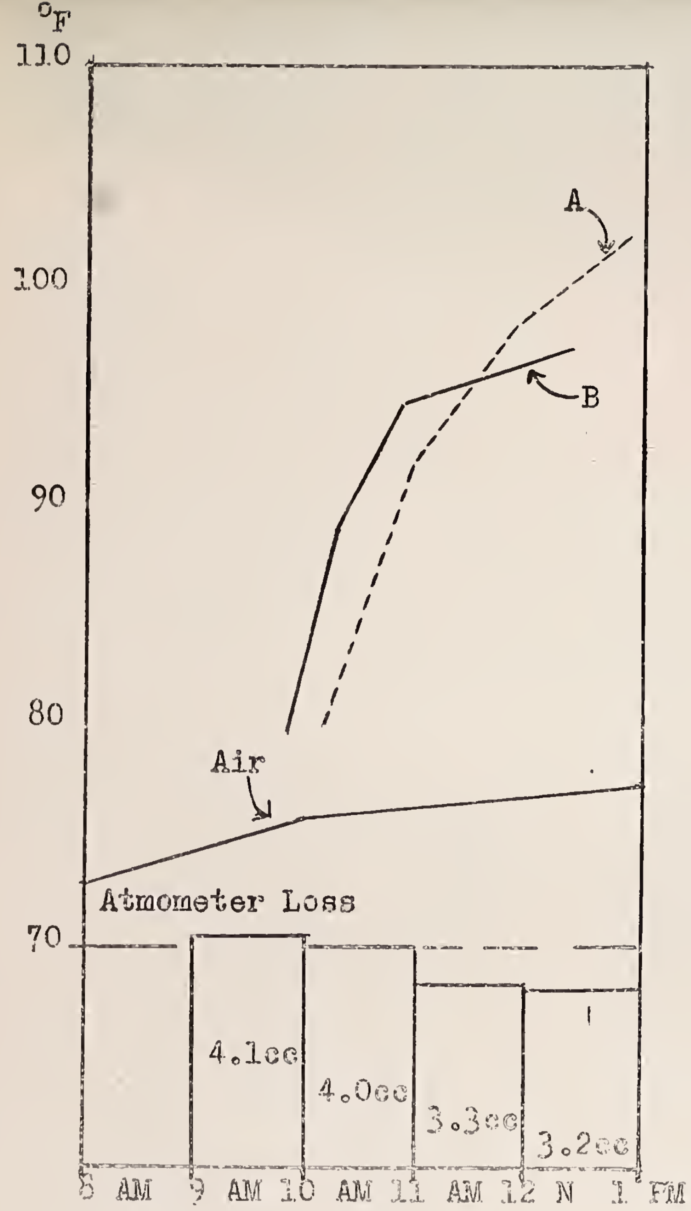

Fig. 4. Average temperature of exposed cortex of slightly skinned potatoes (A) and moderately skinned potatoes (B) and related weather data for Test III. Camden, N.C. June-July 1950.

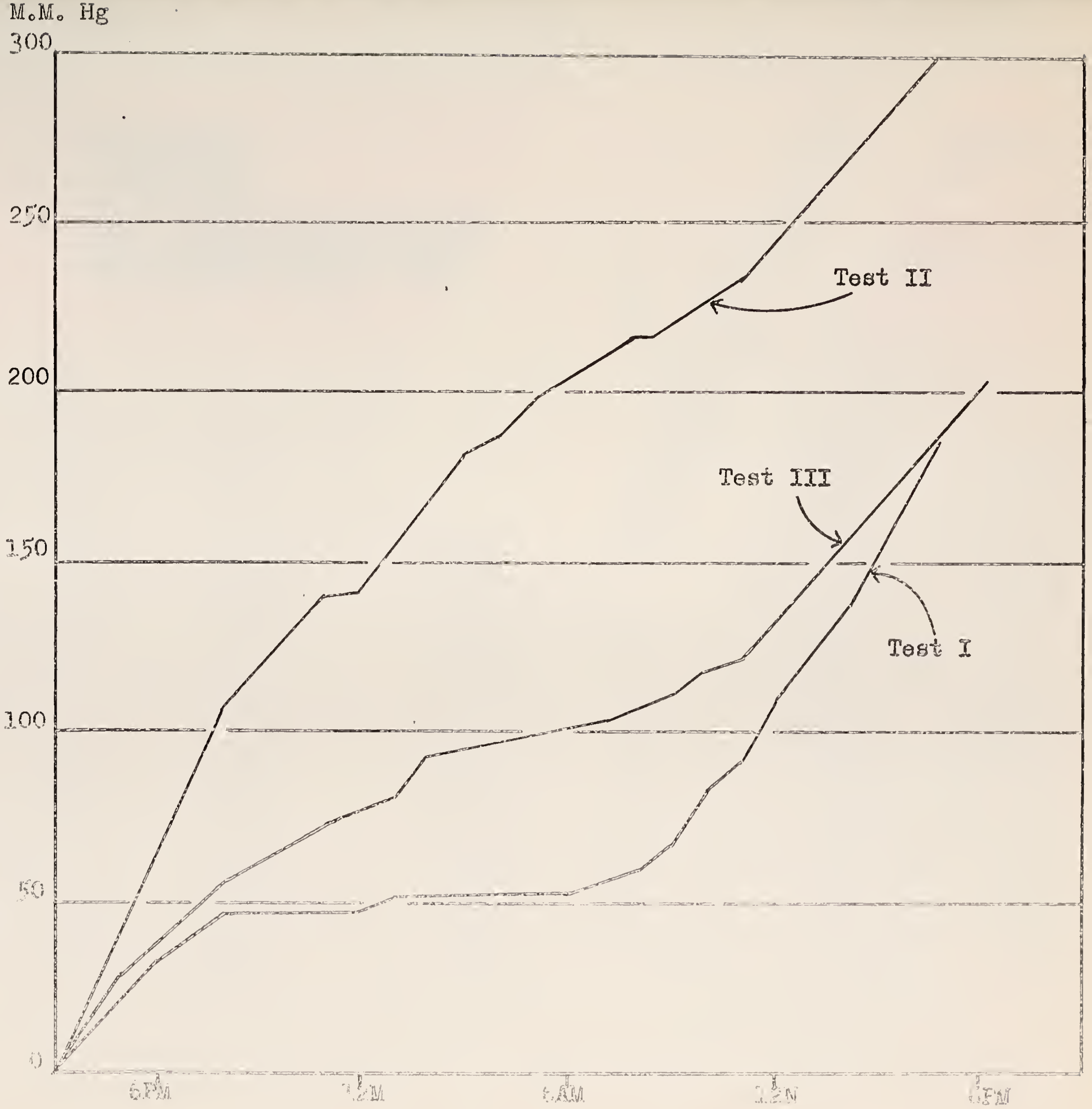

Fig. 5. Cumulative hourly vapor pressure deficits calculated from temperature and humidity records of the air through which Tests I, II, and III passed from Camden, N. C. to New York City, June-July 1950.